

We claim as our invention:

- 1 1. A hydrogen gas generating system, comprising:
 - 2 a membrane electrode assembly including an anode, a cathode and an ionically
 - 3 conductive membrane therebetween;
 - 4 electrical connections for applying electrical power from a source of electrical power
 - 5 to said cathode and anode; and
 - 6 a non-circulating fuel transport system for transferring a water/fuel mixture by
 - 7 capillary action to said anode to generate hydrogen gas.
- 1 2. The invention of claim 1, wherein said non-circulating fuel transport system further
- 2 comprises:
 - 3 a first portion in contact with the water/fuel mixture for transporting the water/fuel
 - 4 mixture to the anode and a second portion in contact with said first portion for collecting
 - 5 gases therefrom.
- 1 3. The invention of claim 2, wherein said first and second portions are interspersed.
- 1 4. The invention of claim 2, wherein said first and second portions are interlaced.
- 1 5. The inventions of claims 2 or 3, wherein
2 said first portion is hydrophilic; and
3 said second portion is hydrophobic.
- 1 6. The inventions of claims 2 or 3, wherein
2 said first portion has higher capillary forces than said second portion.
- 1 7. The inventions of claims 2 or 3, wherein
2 said first portion has a smaller effective pore size than said second portion.

1 8. The invention of claims 2 or 3 wherein the non-circulating fuel transport system
2 further comprises:
3 a replaceable fuel water canister.

1 9. A hydrogen gas generating system, comprising:
2 a membrane electrode assembly including an anode, a cathode and an ionically
3 conductive membrane therebetween;
4 a fuel transport system for transferring a water/fuel mixture to said anode; and
5 electrical connections for applying electrical power, from a source of electrical
6 power generated by hydrogen gas, to said membrane electrode assembly to produce
7 hydrogen gas,
8 wherein excess hydrogen gas is produced by said membrane electrode assembly
9 beyond the hydrogen gas directly consumed by said source of electrical power to provide
10 power to said membrane electrode assembly.

1 10. The invention of claim 9, further comprising:
2 a fuel cell.

1 11. The invention of claim 10, wherein the electrical connections further comprise:
2 a series electrical connection between the membrane electrode assembly and the fuel
3 cell.

1 12. The invention of claims 1 or 9, further comprising:
2 a hydrogen gas storage tank associated with said anode for selectively storing the
3 hydrogen gas provided by said membrane electrode assembly and for selectively releasing
4 the hydrogen gas to the source of electrical power.

1 13. The inventions of claim 12, wherein a portion of the stored hydrogen gas is provided
2 to the source of electrical power during startup operations of the source.

1 14. The inventions of claim 10, wherein the cumulative cell-amps of the H₂ generator are
2 greater than the cumulative cell-amps of the fuel cell.

1 15. The inventions of claim 12, wherein the source of electrical power provides electrical
2 power to a load in addition to said membrane electrode assembly, said invention further
3 comprising:

4 a forward regulator for varying the amount of hydrogen gas provided by the
5 membrane electrode assembly to the source of electrical power to enhance load following
6 characteristics of the source for changes in the amount of electrical power required by the
7 load.

1 16. The invention of claim 15, wherein the forward regulator opens to provide hydrogen
2 gas to the source of electrical power during startup of the source.

1 17. The invention of claim 15, wherein said forward regulator opens to provide
2 additional hydrogen gas to the source of electrical power when the operating efficiency of
3 the source is reduced.

1 18. The invention of claim 15, wherein
2 the source of electrical power provides electrical power to a load in addition to said
3 membrane electrode assembly; and
4 said forward regulator varies the amount of hydrogen gas provided by the membrane
5 electrode assembly to the source of electrical power to enhance load following
6 characteristics of the source for changes in the amount of electrical power required by the
7 load.

1 19. The inventions of claim 15, further comprising:
2 electrical connections for applying electrical power, produced by the load during
3 regeneration, to said membrane electrode assembly while closing said forward regulator to
4 store excess hydrogen produced by said membrane electrode assembly in said hydrogen
5 storage tank.

- 1 20. The invention of claim 15, further comprising:
 - 2 a backpressure regulator between said membrane electrode assembly and said
 - 3 hydrogen storage tank;
 - 4 a vent regulator for controlling the pressure of gases being vented by said anode; and
 - 5 a connection for referencing the pressure of said backpressure regulator to said vent
 - 6 regulator to maintain the pressure at said cathode above the pressure at said anode.
- 1 21. The invention of claims 1 or 12 further comprising:
 - 2 a cooling system within said membrane electrode assembly for recovering liquid
 - 3 from gases produced by said membrane electrode assembly.
- 1 22. The invention of claim 21, wherein the cooling system further comprises:
 - 2 at least one cooling port positioned adjacent an upper end of said membrane
 - 3 electrode assembly to condense gaseous water fuel mixture in the gases produced thereby.
- 1 23. The invention of claim 21, wherein gaseous water/fuel mixture condensed adjacent
2 said cathode is returned to said cathode.
- 1 24. The invention of claim 21, further comprising:
 - 2 a hydrophilic transport mechanism for returning the condensed water/fuel mixture to
 - 3 said cathode.
- 1 25. The invention of claim 22, wherein gaseous water/fuel mixture condensed adjacent
2 said anode is returned to said anode.
- 1 26. The invention of claim 25, wherein gaseous water/fuel mixture condensed adjacent
2 said anode is returned to said anode by said water/fuel transport system.
- 1 27. The invention of claim 26, wherein said membrane electrode assembly and water/fuel
2 transport system forming a first cell, the invention further comprising:
 - 3 one or more additional cells positioned adjacent said first cell to form a stack;

4 current collectors position between each cell and at the beginning and end of the
5 stack; and

6 additional cooling ports positioned in an upper end of one or more of said current
7 collectors.

1 28. The invention of claims 1 or 9 wherein the membrane electrode assembly further
2 comprises:

3 a spiral coil.

1 29. The invention of claim 28, further comprising:

2 a housing surrounding the spiral coil,
3 a hydrogen outlet at one end of the housing; and
4 a fuel water canister at the other end of the housing.

1 30. The invention of claim 29 wherein said housing is generally cylindrical.

1 31. The invention of claim 29 wherein said hydrogen outlet forms a first electrode.

1 32. The invention of claim 31 wherein said fuel canister forms a second electrode.

1 33. The invention of claim 29 wherein said fuel canister forms a second electrode.

1 34. The invention of claim 31 further comprising:

2 a hollow central core within the spiral coil for venting CO₂ formed within the spiral
3 coil.

1 35. The invention of claim 34 further comprising:

2 a backpressure regulating valve system in said housing in communication with said
3 hydrogen outlet and said hollow central core.

1 36. The invention of claim 35 further comprising:

2 a CO₂ supply line between the spiral coil and the fuel canister to pressurize the
3 water fuel mixture.

1 37. The invention of claim 34 further comprising:
2 a CO₂ supply line between the spiral coil and the fuel canister to pressurize the
3 water fuel mixture.

1 38. The invention of claim 29 wherein said housing further comprises:
2 a hydrogen storage volume in communication with the spiral coil.